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DEPARTMENT OF PUBLIC HEALTH, BRISBANE.

REPORT

ON THE

OUTBREAK OF PLAGUE

IN

THE STATE OF QUEENSLAND,

1903.

FEBRUARY-MAY, 1903.

BRISBANE:

BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

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Report on the Outbreak of Plague at Brisbane.

FEBRUARY—MAY, 1903.

Department of Public Health,

1st July, 1903.

SIR,—I have the honour to submit, for the information of the Honourable the Minister, and the State Health Authorities of the Commonwealth, a brief summary of the facts regarding the recent outbreak of bubonic plague in the State of Queensland.

The outbreak, the fourth in Queensland, consisted of twenty-six cases with fourteen deaths, distributed as follows:—

	Cases.	Deaths.
Brisbane	19	9
Rockhampton	2	2
Townsville	3	2
Bundaberg	2	1
Total	26	14

The gross fatality was thus 53·8 per cent., but five of these patients were Chinese, a race amongst whom the mortality of plague is usually high, whilst several of the cases, including two at Brisbane, were only discovered by post-mortem examination.

The recent outbreak in Brisbane began on the 8th February, 1903, and ended on 23rd of May, 1903, and up to date has furnished a smaller number of cases—nineteen in all—than any of the previous outbreaks of plague. As in former years, the disease was sporadic in character, and bubonic in form, and in no instance was there direct evidence of the spread of infection from person to person. The segregation in a “contact” reception-house of persons who had been in association with the infected houses has long since been discontinued, “original” contacts being kept under observation only for a period of five to six days. There was no evidence that the freedom allowed them was prejudicial.

It would seem, therefore, that infectivity depends upon the type it assumes in the individual patient, and in Case III. (Appendix C), reported by Dr. O'Brien, the resident medical officer at Colmslie Plague Hospital, every precaution was observed to place the patient in strict isolation. Variation in type was more carefully watched for than variation in severity of attack. With regard to the latter, the case reported by Dr. O'Brien is of more than usual interest in the length of illness of the patient and the complications which subsequently developed.

The outbreak throws no further light on the epidemiology of plague.

Every case was definitely proved by clinical and bacteriological evidence of a convincing description.

A large proportion of “suspect” cases was negatived.

A clinical feature to which one or other of our clinicians has attached some importance is the full but soft pulse of the patient in the period of invasion.

The curative serum was administered in large doses, both subcutaneously and intravenously.

We are still somewhat at a loss as to the manner in which many of the patients became infected.

Our cases failed to reveal any evidence of the point of entry of the poison into the body as marked by any specific lesion.

In an attempt to focus the facts indicating the spread from rat to man, or man to rat, no clear light can be thrown upon the question as to how the recent outbreak originated.

That rat mortality is a precursor of plague in man, and that plague is usually preceded by an epizootic amongst rats, is now practically the general consensus of opinion throughout the world where plague has been observed.

No information with regard to sickness or unusual mortality amongst our rats was forthcoming.

"No rats, no plague," is a truism which supplies a remedy as well as a warning, but there are many factors in the rat question which are as yet very imperfectly understood.

Dr. J. E. F. McDonald, Health Officer for Brisbane, and member of the official staff of the Department of Public Health, in his Report (appended) raises the question as to whether plague was enzootic amongst rats, or possibly other animals, in a chronic form which was unnoticed.

"The animals of the farmyard, and of the backyard of domestic dwellings," mentioned by Professor Simpson (in a summary of his Report on plague in Hong Kong, published in the *British Medical Journal*, 28th March, 1903), as susceptible to plague in a chronic as well as an acute form, furnish an interesting and important fact as bearing on the endemic maintenance and dissemination of the disease by infected animals and poultry in addition to infected rats or mice.

With the exception of rats and mice, the influence of animals in spreading the disease has been in our experience inappreciable.

Of three cats examined during the recent epidemic in Brisbane, two were found dead on premises from which infected persons were removed, whilst the third animal was observed to be sick. Careful bacteriological investigation failed to reveal the presence of plague bacilli in all three instances.

As to the question of transference of plague bacilli by the agency of suctorial insects, &c., Mr. C. J. Pound, the Government Bacteriologist, and Dr. O'Brien, in their Reports (appended), mention several interesting facts in this connection.

During the hot summer months the plague wards swarmed with mosquitoes, and both patients and nursing staff were constantly bitten. Examination of mosquitoes (Culicidæ), caught after feeding on a patient (Case III.), septicæmic in type, gave negative results, but from two specimens which had fed on the body of another patient (Case XV.), bacilli were separated which, in their morphological and cultural characters, were identical with the *Bacillus Pestis*.

An interesting observation in connection with the possible accidental transmission of plague from rat to rat by the agency of cockroaches is related by Mr. Pound. (See Appendix E.)

With regard to the dissemination of plague among rats through the agency of fleas, Mr. Pound, in a voluminous Report on various experiments and observations conducted at the Bacteriological Institute in connection

with the four outbreaks of plague in Brisbane, mentions the following episode:—A live rat, apparently healthy, caught on the premises from which a plague patient had been removed a few days previous, was placed in a wire cage containing nine other healthy rats. These latter rats, all of one family, had been reared at the Institute, and were about twelve months old. They were kept for laboratory experimental purposes, &c. These rats were always in a healthy condition, and “on no occasion whatever were fleas or other parasites found on them.” Within five days of placing the rat in question in the cage along with these healthy rats, five out of the ten rats died, and the remaining five were in a dying condition. *Post-mortem* and bacteriological examination revealed the fact that the whole ten rats were infected with plague. Fleas were found on the bodies of two of the rats and “in the bodies of several fleas plague bacilli were discovered.”

The first infected rat this year was found on the 9th of January last, the first case in man was reported one month later, on the 8th February. Recognising the extreme importance of the agency of rats in the dissemination of plague, the Health Department has made special efforts during the last twelve months in the work of rat destruction. A gang of twenty men, under a competent inspector, has constantly been employed in laying poisoned baits, trapping, digging out burrows, destroying nests, and breaking up the habitual haunts of the rodents.

The actual number of rats destroyed by the gang was out of all proportion to the number collected for examination, and it is difficult to estimate the effect on the rat population which was produced. After taking poisoned baits, rats retire to their holes to die; and the number of rats killed by householders would, if added to the total actually gathered by the rat gangs, increase the grand total considerably.

An attempt was made during the month of March last for a rat drive on a large scale, the permanent gang being increased by the addition of 100 men for several weeks. Good work was accomplished, but the results were, comparatively, little better than those obtained by the steady and systematic work of the present gang of the department in their every-day operations.

Both infected premises and infected rats were confined to a much smaller area—practically the city proper—than in any previous outbreak. The presence of infected rats on premises where indigenous cases had occurred was demonstrated fairly often enough to support the now generally accepted proposition “that the danger of contracting plague stands in relation to the presence of rats in dwellings or enclosed premises.”

Plague-infected rats, however, were found time after time on premises where no case of human plague had occurred, but in one of the earlier cases some 200 or more dead carcasses of rats* (uninfected) were removed from beneath the floors of a granary in close proximity to the house of a patient.

Case XI., reported by Dr. McDonald, lived in the vicinity of a slaughter-yard, from which the decomposed remains of 250 rats and sixty living ones were obtained. Of these latter, two were found infected.

Of 134 mice collected and examined, four were found to be infected.

*Owing to the advanced nature of decomposition in these carcasses, it was impossible to state whether these rats were dead of plague or of poison.

The importation of ship-borne rats and intercommunication between shore and ship rats was prevented, so far as it was possible to do so, by the stringent enforcement of the plague regulations relating to the mooring of vessels while in port. By interstate agreement every vessel leaving Queensland ports carried a fumigation certificate certifying that such vessel had been fumigated while empty at the port of departure.

Of 16,409 rats collected in Brisbane during the last twelve months, 9,530 were examined bacteriologically, and 91 were found to be infected, or a percentage of less than 1.

The following comparative table shows the cases of plague in rats for the four outbreaks—namely, 1900, 1901, 1902, and 1903, in Brisbane:—

Year.	No. Rats Examined.	Found Infected.	Percentage.
1900	590	95	16·1
1901	1,809	101	5·58
1902	1,315	*96	7·3
1903	*6,500	*80	1·23

* January to June.

From the above figures it will be noted that 2·54 times the average number of rats were examined during the 1903 outbreak than at previous periods; the percentage of infected rats—namely, 1·23—being the lowest on our Brisbane records so far.

The number of cases of plague in man reported during the present year is also lower than in any previous year.

Monthly comparative statement of cases of plague in man and rats for the four outbreaks in Brisbane:—

Month.	Man.				Rats.			
	1900.	1901.	1902.	1903.	1900.	1901.	1902.	1903.
January ... ..	...	...	1	..	...	...	3	1
February ... ..	...	1	14	5	...	...	6	7
March ... ..	...	7	20	4	6	...	7	31
April	3	7	28	6	3	16	52	20
May	10	12	18	4	4	23	16	15
June	10	3	...	..	15	32	12	6
July	14	3	...	...	21	20	8	...
August	4	1	1	...	24	8	1	...
September	5	..	...	...	15	1	...	...
October	4	1	..	...	7	...	..	...
November	3	...	...	...	...	1	...	...
December	3	1	...	...	...	...	...	...
	56	36	82	19	95	101	105	80

Cases of plague in man and rats were also reported at the following places in the State:—

	Man.		Rats.	
Townsville	3	...	49	(of 4,016 collected.)
Rockhampton	2	...	...	(of 5,448 ,,)
Bundaberg	2	...	...	...

A statigraphic chart showing the weekly totals of cases in man and rats, the monthly rainfall, the grand mean temperature and vapour tensions, &c., for the four years has been prepared, and this chart, together with a map of the distribution of the cases, will be included in my detailed Report, now in course of preparation.

There is, apparently, a certain periodicity—a season of activity alternating with a period of quiescence—but it is with extreme caution that even the law of average itself can be applied to the facts and figures at our command.

The cases in man were observed to begin during the hot, moist, or “muggy” season of the year—January and February—reach their limit about the end of May, and notably decline at the beginning of June, when the colder season with the westerly winds set in. Thus our experience of plague in Queensland is in direct opposition to plague in India, where in the latter country an epidemic increases rapidly during the cold season and declines during the hot weather.

A question to be asked is, “When plague ceases for several months in a town, is the germ dead, or is it merely dormant?”

Klein (L.G.B. Reports, 1896-97) states that the plague bacillus is killed by thorough drying; and the influence, if any, of a cold extremely drying wind such as the “westerly” with which Queenslanders are familiar during the colder season of the year, in inhibiting the activity of the plague bacillus, is a point on which I think it would be interesting to collect evidence.

All observers up to the present time have connected the occurrence and diffusion of plague with filth. But while it can be shown that filth *per se* has but little influence, there is no doubt that modern sanitation and the introduction of a higher standard of public and domestic cleanliness is regarded, and rightly regarded, as of the very highest importance in the prevention of plague.

In the so-called “stamping out” process of plague the best results have appeared to follow the removal of filth and garbage from premises, but, above all, the steady and systematic scavenging of districts well and wisely directed. All local authorities were reminded of their powers and duties under the Health Act, and sanitation has been vigorously carried on as, perhaps, never before.

In May of last year, consequent on my cleansing “Order,” the municipality of Brisbane received a thorough cleansing of all dirty areas within its boundaries. Some 3,000 loads of refuse were removed.

Metal garbage boxes, fitted with cover, were provided to every householder, and a special by-law was passed by the Municipal Council compelling householders to place the refuse of the kitchen, &c., therein.

Immediately following this special cleansing a notable decrease in the number of cases of plague was observed. From twenty-eight cases in April, and eighteen in May of last year, no further case (with the exception of one sporadic case in August) occurred until the 8th of February this year—a quiescence of nearly nine months.

In November of last year three cases of plague occurred at Townsville, where for some months previous to the outbreak plague-infected rats had

been found. A cleansing "Order" was carried into effect by the Townsville Municipal Council, and some thousands of loads of filth removed from the town.

The last case of plague occurred there on 26th November, 1902, and since that date there has been no further development.

Specimens of rats—infected and healthy—were collected from different towns in the State—*e.g.*, Brisbane, Townsville, Rockhampton, Bundaberg, Gladstone, Ipswich, &c., and referred to the Director of the Queensland Museum (Mr. C. W. de Vis) for purposes of identification and classification. Mr. de Vis reports: "The 'infected' rats sent to me are for the most part black rats, *Mus Rattus*, in one or other of the colour varieties of that species; a considerable number of them the reddish variety known as *Mus Alexandrinus*." Another species more commonly found infected here is the grey, or Norway rat, the *Mus Decumanus*.

Several hundred fleas taken from rats—infected and healthy—were referred to the Government Entomologist (Mr. Henry Tryon) for report as to their specific identity. Mr. Tryon's full report is not yet to hand, but an *interim* report states that the collection embraces examples of the under-mentioned species of Pulicidæ:—

- (1) *Pulex Irritans*, Linn.
- (2) *Typhlopsylla Musculi*, Duges.
- (3) *Pulex* (species indetermin., ? *Fusciatus*, Bose d'Anties).

In July of last year the administration and execution of the Plague Regulations were transferred from the control of the local governing bodies as constituted in the various "Joint Boards for the Prevention of Infectious Diseases," to the Department of Public Health.

The Commissioner of Public Health has now complete and sole control of the Plague Regulations, the Central Health Authority, under the Government being supreme in all matters relating to plague, cholera, and smallpox.

Recognising that plague is a disease affecting the whole community, the Government now bears the whole cost of the work of administration and prevention throughout the State.

In all the important towns along the coast a health officer has been gazetted to carry out the Plague Regulations, such officer acting as the deputy of the Commissioner.

The following is a brief scheme of action adopted:—

1. Notification of all cases of plague or suspicious cases to the Commissioner.
2. Investigation of the case by the Health Officer.
3. Bacteriological examination of "specimens" by the Health Officer and the Government Bacteriologist.
4. Isolation of patients in hospital.
5. Supervision of "contacts" during the incubation period. (Segregation of "contacts" now abandoned except in cases of Pneumonic Plague.)
6. Fumigation of infected houses, clothing, bedding, &c.

7. Cleansing and disinfection of infected areas by the medical and sanitary staff of the Health Department.
8. Destruction of rats.
9. Bacteriological examination (daily) of rats.
10. Supplies of curative serum to the Health Officers and general hospitals.
11. Protective inoculation. (Confined at present to members of cleansing gangs.)
12. Inspection of the districts for detection of nuisances, &c.
13. Dissemination of literature among medical officers of health, practitioners, &c.
14. Fumigation of coastal vessels with a view to the destruction of rats.

Acting in the spirit and letter of the Venice Convention, the Queensland Health Department has always given the fullest information to the State Health Authorities, and made public the fact as to plague within this State.

I have the honour to be,

Sir,

Your obedient servant,

B. BURNETT HAM, M.D., D.P.H. (Camb.).

Commissioner of Public Health.

The Under Secretary,
Home Secretary's Department.

APPENDIX A.

OUTBREAK OF BUBONIC PLAGUE IN BRISBANE DURING THE
FIRST SIX MONTHS OF 1903.

CLINICAL REPORT.

During this period nineteen cases were reported and came under observation; of these, nine were fatal. Two of these latter, however, were only discovered post-mortem. All the cases were confirmed bacteriologically. In most, cultural and inoculation experiments were performed in addition to microscopic examination.

CAUSE OF THE RECRUDESCENCE.

The last case occurring in Brisbane during 1902 was on 4th August; the last infected rat found during 1902 was on 27th August; the first infected rat of 1903 was found on the 9th January, and the first case was reported on 8th February.

The questions therefore arise :—

- (1) Was infection latent in the soil in Brisbane during the six months of quiescence; or
- (2) Was it enzootic amongst rats, or possibly other animals, in a chronic form, which was unnoticed; or
- (3) Was plague entirely absent from Brisbane during those months, and its recrudescence due to re-importation in December or January? (It may be noted that rat-infection was present at Townsville at this time, and possibly in other Northern towns.)

Taking our experience of past years and other facts into consideration, I am inclined to think that (2) is the probable explanation.

GENERAL FEATURES OF THE OUTBREAK.

The progress of the disease during the first six months of 1903 is shown by the following table, which may be compared with the years 1900, 1901, and 1902 :—

Month.	1900.	1901.	1902.	1903.
January ... ..	...	...	1	...
February ... ..	...	1	14	5
March ... ..	...	7	20	4
April	3	7	28	6
May	10	12	18	4
June	10	3	...	...
July	14	3	...	...
August	4	1	1	...
September	5	...	...	...
October	4	1	...	...
November	3	...	...	...
December	3	1	...	...
	56	36	82	19

As in previous years the cases were essentially sporadic in character, and in no instance was there evidence of infection from one case to another, either directly or indirectly.

The cases were distributed over a smaller area than in 1902, and were practically confined to the city proper, as regards their source of infection, as far as could be ascertained.

Actual sanitary defects appeared to play little or no direct part in determining the incidence of the disease.

In a certain proportion of the cases a relation could be traced between the occurrence of infected rats in a locality and infection in human beings.

RAT INFECTION.

From the 1st January, 1903, to 14th June, 6,500 rats were bacteriologically examined, and of these eighty were found to be infected—*i.e.*, 1·23 per cent.

For the same period of 1902, 1,315 rats were bacteriologically examined, and of these 96 were found to be infected—*i.e.*, 7·3 per cent.

The following table shows the number of infected rats found each month during the first six months of the years 1902 and 1903:—

	1902.	1903.
January	3	1
February	6	7
March	7	31
April	52	20
May	16	15
June	12	6

Speaking generally, infected rats were found distributed over a much smaller area than in 1902, being practically all obtained in the city proper.

It was noted in a number of instances that infected rats were obtained during this year from the same localities that infected ones were obtained during 1901 and 1902; this fact may indicate that immanent soil or rat infection existed in these localities, or simply that these quarters afforded attractions for rats, hence they migrated there; or that these quarters were of easy access to rats from some central focus, owing possibly to defective sewerage, or to other means of spread.

It may be remarked that a large proportion of the infected rats caught during the latter part of the half-year came from city wharves; this may possibly be explained by the fact that many of their regular runs in the city were broken up, and they retreated here to quarters where the usual means of eradication must fail.

INCIDENCE OF THE DISEASE.

Age.—The age of the majority of these cases was between the years 10 to 30, the extremes being eight and fifty years.

Sex.—As noticed in past outbreaks here the males outnumbered the females, the figures being 13 males and 6 females.

Occupation.—A large proportion of the cases was connected with grocery and produce stores and stables.

CLINICAL FEATURES.

All the cases presented definite buboes, there being none of the so-called primary pneumonic or septicæmic cases.

In the majority the primary bubo was in the femoral region; it was frequently accompanied by smaller glands in the inguinal region of the same or opposite side. The primary bubo usually appeared on or about the second day of disease.

In two cases local lesions, in which the presence of *B. Pestis* was demonstrated, were present in the drainage area of the affected glands.

The onset in the majority of the cases was very sudden, the first symptoms being commonly vomiting and frontal headache; a rigor or some shivering was frequently noted early in the attack.

PREVENTIVE MEASURES.

In addition to the ordinary measures of general sanitation particular attention was paid to destruction of rats throughout the city and suburbs; 12,189 being accounted for from 1st January, 1903, to 19th June, 1903.

Disinfection of premises where cases occurred was instituted as soon as the nature of the disease was ascertained; no instance of a second case occurring after disinfection was noted.

"Original" contacts were kept under observation for five days, but not otherwise dealt with.

In the event of infected rats being discovered in any premises, special attention was paid to their eradication there, and to the elimination of all conditions likely to attract them.

J. E. F. McDONALD, M.B.,
Health Officer.

APPENDIX B.

NOTES ON THE ETIOLOGY OF NINETEEN CASES DURING THE FIRST SIX MONTHS OF 1903.

CASE No. I.

Clerk by employment, but out of work for some time. Lives in healthy spot on Rutledge's Hill, Paddington. Has been in the habit of visiting Case No. III. at the shop where the latter works in Edward street.

CASE No. II.

Works as an engineer on premises near the river bank at Petrie's Bight. A sewer opens into the river near the works, and it was along the line of this sewer that a chain of cases took place in 1901 and 1902.

CASE No. III.

Grocer's assistant. Works at a shop in Edward street. Sickened a day or two before Case No. I., who was probably infected from the same source.

CASE No. IV.

Lives in a house in the yard of a large flourmill. Large sheds, containing stored maize and wheat, adjoin the house. Rats are always plentiful, owing to abundance of feed. One large shed, containing maize, has its floor only 3 or 4 inches from the soil, and when this was taken up the carcasses of several hundred rats were unearthed. Many of these must have died from poison, as the rat gang had always given this place special attention. A week before the child sickened the flooring of the kitchen had to be taken

up in places to remove the dead bodies of decomposing rats. The father says he has often seen rats in a stupid and dazed condition near the granary, and he has killed them with a stick on several occasions. This case appears to have developed the disease in the submaxillary glands first, as inguinal and femoral buboes did not make their appearance till the illness had lasted five or six days. Plague was not suspected by the medical attendant till the involvement of the inguinal glands became apparent.

CASE No. V.

Worked in the basement of a Queen street premises. There were numerous traces of rats throughout the building, but no dead ones were found nor were any infected ones obtained. On the other side of the street, directly opposite these premises, infected rats have been frequently obtained.

CASE No. VI.

Worked in a produce store in the Valley, and lived over the shop. Numerous traces of rats were observed throughout the building, but no rats were obtained.

CASE No. VII.

Lived at Spring Hill and worked in the Government Printing Office. No signs of rats were found at either home or at the printing office. Spring Hill area supplied several cases during 1901 and 1902.

CASE No. VIII.

Lived opposite to the flourmill which supplied case No. IV. No signs of rats were found at her home.

CASE No. IX.

Lived in George street. Three days before she was taken ill the floors of two bedrooms on the ground floor, adjoining the kitchen where she worked, were taken up and five decomposed rats were found. These premises are adjoining some Roma street produce stores, which about that time yielded several infected rats.

CASE No. X.

This case is discussed elsewhere.

CASE No. XI.

Lived with his parents at Downfall Creek, a scattered settlement about 7 miles from Brisbane. His father was slaughter-man at a neighbouring slaughter-yard, and deceased was in the habit of going every morning to the yard with his father's breakfast and remaining there for half an hour or an hour.

On inquiry at the slaughter-yard, the following facts were elicited:—

Rats, until about 3 weeks previously, had been very numerous at the yard, but since that they had been dying in great numbers; every morning numerous dead ones were raked up and burnt; sick ones, which appeared dazed and could be easily knocked over, were frequently observed.

The slaughter-yard was thoroughly overhauled, and the decomposed remains of 250 rats were obtained and sixty living ones; of these latter two were found, on bacteriological examination, to be plague-infected.

As throwing a light as to how the infection was possibly carried to this yard, it is interesting to note that, on several occasions previous to this, infected rats were found at the head town shop of this slaughter-yard and in the immediate vicinity of this shop.

From this town shop various butchering refuse and offal were brought to the yard to be dealt with, and also the forage for the horses at the yard was first sent to the town shop from the produce stores, and then transported from the shop to the yard. To me, it is quite conceivable that an infected rat was carried amongst the offal or the forage from the town shop to the slaughter-yard at Downfall Creek, thus causing an epizootic amongst the rats there.

CASE No. XII.

Lived at Newstead, and was occupied with domestic duties at home. The etiology of this case is obscure as no signs of rats were observed in her home, nor were any infected rats obtained in the neighbourhood, though it was thoroughly worked for rats.

CASE No. XIII.

Sanitary cart driver, lived at South Brisbane; his stables were on the North Quay, not far from the flourmill which supplied Case No. IV. There were numerous traces of rats at the stables, and six live ones were captured there, but they were healthy.

CASE No. XIV.

Lived at New Farm, and worked at a boot factory in Edward street. No signs of rats were noticed at home, but there were numerous traces of them at the factory, and on overhauling it four decomposed rats were found there. Infected rats have frequently been obtained in this neighbourhood. Case No. III. worked in premises opposite the factory.—*Vide also* Case No. I.

CASE No. XV.

Lived at Woolloongabba, and worked in a brick and cement warehouse in Creek street. No signs of rats at home, but there were numerous traces throughout the warehouse, although no rats could be collected. The warehouse is close to wharves which have supplied several infected rats.

CASES Nos. XVI. AND XVII.

Lived at Billet street, Spring Hill. Case XVI. was in the habit every morning of carrying breakfast to Case No. XVII., at the latter's stables in Tank street; case No. XVII., who lived at Isaacs street, Spring Hill, being employed as a cartier. Case No. XVI. usually remained at the stables for about half an hour to an hour. The onset of the disease in both these cases was practically simultaneous. About a week previous a dazed rat was seen in the stable yard, and on the same day a dead one was also seen there.

At the stables numerous traces of rats were found, and four decomposed rats were obtained.

CASE No. XVIII.

Living in Queen street. Traces of rats were found in some out-buildings in the yard of her home. These premises are in the immediate vicinity of shops where infected rats have been several times found during this year.

CASE No. XIX.

Chinese fruiterer, living in his shop in Brunswick street. Traces of rats were found throughout the premises.

Cases I., II., III., and IV. are reported by Dr. Wilton Love.

J. E. F. McDONALD, M.B.,
Health Officer.

APPENDIX C.

INFECTION AND ONSET.

Note on Mosquitoes.—The Plague Hospital premises swarmed with mosquitoes, mostly of the *Culex* type, and in spite of the use of nets and smoke fires, the patients were continually bitten. A specimen of *Anopheles* was occasionally captured in the wards but no instance of *Anopheles* biting a patient or nurse was observed.

It was reported by two of the nurses that they had observed mosquitoes, after feeding on Case III., fall over apparently dazed on the bedclothes. However, on examining several mosquitoes caught just after feeding on this patient at various times, nothing resembling a bipolar bacillus was observed except on one occasion an appearance as of disintegrating bipolar bacilli mixed with stomach contents. At this time it was not found possible to discover bacilli in frequent smears of finger blood.

From Case XV., bipolar organisms were obtained *via* mosquitoes. Two *Culices* which had fed on the patient's body when he was *in articulo mortis* were macerated in sterile water and subcultured. Bacilli were separated which stained in the typical bipolar manner of *B. Pestis*, lost the stain in Gram's method, and later on developed involution forms on agar resembling those of *B. Pestis* very closely. Unfortunately, an inoculation experiment on a guinea-pig was not carried out, but as the patient's blood at this time contained numerous *B. Pestis*, it seemed extremely likely that the organisms isolated from the mosquitoes were *B. Pestis*.

The nurses were being incessantly bitten, and though on one occasion there were three cases in the wards with numerous *B. Pestis* in the general circulation, yet there was no case of infection amongst the staff this year.

In this connection it is interesting to recall the case of a staff nurse who suffered from pestis in 1901 at the Plague Hospital. She was bitten on the face by a mosquito in the ward. At the site of the bite a few days later (number not accurately recorded) an inflammatory sore developed with a central sloughing core. Then the submaxillary glands on the same side became enlarged and tender, and she developed a typical attack of plague, which fortunately ended favourably.

The irritable mosquito-bite may have been subsequently infected by her hands; but, at all events, the agency of the mosquito in causing the infection cannot be altogether excluded.

Case X.—An interesting case was that of an employee of the Health Department engaged in handling rats.

On a Tuesday, while engaged manipulating rats at the Bacteriological Institute, this man stabbed his hand with a pair of scissors. The wound was cleansed with 5 per cent. carbolic lotion, and healed rapidly. On the Thursday following (on which day one infected rat was found), while chopping wood at the rat cremation furnace, he was struck on the upper arm by a piece of wood, which abraded the skin. On Thursday, Friday, and Saturday he complained of being "seedy," and ate very little. On Sunday he felt "very ill," and his arm around the sore felt hot and painful; during the day this pain and soreness spread to the axilla.

He was seen by the Commissioner of Public Health that evening, and the wound was treated with pure carbolic acid crystals.

Neither then nor the next morning when he was examined by Dr. McDonald were his symptoms considered very suggestive of plague. On the Tuesday when examined he was much improved, but that evening he had a severe rigor, and next day (Wednesday) clinical and bacterioscopic evidence confirmed the case as one of pestis. On several occasions bacilli were found in the local sore, to which the pure carbolic was applied on Sunday, and not once in the enlarged tender glands in the axilla.

DIAGNOSIS.

Agglutination Methods.—It was hoped that as a result of researches by numerous observers on agglutination, and on “hanging-drop” clumping and inhibition of growth, it would be possible to demonstrate with some certainty the presence of pestis in those cases in which it is so difficult to demonstrate bacilli, particularly those presenting themselves late in the disease, and in very mild or ambulant cases.

Though my opportunities have not been sufficiently numerous to form any decided opinion on this point, it would seem even from Cairns’ and Stricker’s observations that it is these same cases in which the agglutination reaction is so difficult to demonstrate.

The “hanging-drop” method also seems, as far as my limited series of experiments went, to be inconclusive in these same cases.

INTERESTING FEATURES IN CONNECTION WITH TYPES AND LENGTHS OF CASES.

Length of Case.—Case III. lived for eighty-one days after admission to the Plague Hospital, during the whole of which time intractable diarrhœa, with involuntary evacuations, persisted, resulting eventually in bedsores which, with their inevitable constant pain, sleeplessness, and sapræmia, materially hastened the end.

The temperature throughout was extremely high, scarcely ever being below 102 degrees until within eight days of death, and ranging daily up to 103.4-5 degrees, resisting alike serum, baths, quinine, and anti-pyretic drugs. This sapræmia and, later, septicæmia, were accounted for by finding eventually that the chain of glands extending from the upper femoral deep regions to the brim of the pelvis behind the peritoneum had broken down into what was practically a tunnel full of pus and sloughing breakdown glands, from which a pure culture (morphologically) of bacilli pestis was recovered at the autopsy. From the urine at the same time was obtained a pure culture of the same organisms.

Pulmonary complications.—Two cases came under observation. The first (XIV.) was apparently recovering from pestis, and had reached the eighth day of his attack with temperature falling, and respirations never above 30, and entire absence of abnormal physical signs in the chest when he suddenly presented symptoms of lobar pneumonia about midday, and was dead by 6 a.m. next morning.

The second case (XV.) admitted with temperature 102, pulse 90, respirations 26; spat up blood-stained mucus which contained a pure culture of *Bacillus Pestis* (guinea-pig died in four days) on his second day in hospital, developed a cough next day, a “patch” of broncho-pneumonia on the fourth day, and died on the 14th day.

The first case was lobar pneumococcal pneumonia, confirmed by clinical, bacteriological, and *post-mortem* examinations.

The second differed in every respect, and was a lobular pestal broncho-pneumonia.

Both cases developed swollen glands in the neck.

Sudden fatal heart failure.—This case was admitted with temperature 104, pulse 160, respirations 40, responded well to 200 C.C. serum given intravenously, the temperature dropping to 100 degrees next day, with pulse 140, respirations 32. At 7 a.m. next morning his pulse presented no change to either of his two nurses who examined it, yet at 7.15 a.m. he

suddenly paled and gasped, and within a minute or two his heart had completely stopped. This case of sudden death, when a most hopeful prognosis seemed quite justifiable, and the sudden oncoming of fatal lobar pneumonia in Case XIV. when, in both cases, the patient was apparently safe as far as any further constitutional effects of pestis were concerned, demonstrate the wisdom of a very cautious prognosis until the temperature has been normal for some days.

Heart lesions persisting.—Of the twelve cases discharged from the plague hospital, three of the female patients (æt. 12-20) had persistent slight arrhythmia and soft systolic bruit at all areas. In Case VII. the sounds were not even fairly clear until the ninth week, and in Cases VIII. and XVII. the systolic bruit still persists, having been present now sixteen and seven weeks respectively.

BACTERIOLOGY.

The importance of keeping a complete bacteriological check on all abscesses, &c., in hospital was forcibly brought home by the fact that in the sinus in the groin of Case III. *B. Pestis* were found to the day of death (eighty-one days), and up to the fifty-fifth day grew freely on agar.

Again, on one occasion when bathing Case XIV. the collodion covering applied over the sloughing gland became detached, and the whole quantity of water in the bath was found to be liberally infected with *B. Pestis*; this occurred on the ninth day of his illness.

TREATMENT.

Serum.—All the fresh evidence in relation to serum treatment leads me to agree with the opinion expressed in the Plague Report (Brisbane, 1901-2) that with serum given subcutaneously or intravenously "in large doses, nearly every case of ordinary bubonic plague—apart from fulminant or septicæmic cases—should get well," if treatment is commenced sufficiently early.

In cases with pulmonary complications, observers generally agree in expecting a very high mortality even in the presence of serum treatment. The only two such cases that occurred this year resulted fatally.

Serum rashes.—On several occasions suprarenal extract was tried in urticaria, and though the evidence was far from conclusive, the idea was formed that the urticaria did disappear shortly after the administration of the extract.

Use of serum intravenously.—The Institut Pasteur serum in use during this epidemic contained a large amount of sediment, with pieces so large that the possibility of embolism practically prohibited its use intravenously in the unfiltered condition.

Believing firmly in Roux and Calmette's advice, given in the Oporto outbreak, recommending the use of serum intravenously as well as subcutaneously in severe cases, I filtered the serum through sterile wool, warmed it to body temperature, and injected the clear liquid intravenously in severe cases. The removal of the sediment did not appear to affect the marked relief afforded by the serum in severe bubonic cases.

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The Commissioner of Public Health.

APPENDIX D.

No. of Case.	Sex.	Age.	Occupation and Place Employed.	Date of Admission to Plague Hospital.	How long Ill before Injection of Serum.	Total Quantity of Serum Injected in C.C. S.—Subcutaneously. I.—Intravenously.	Clinical Course.	Result.
I.	M	26	Clerk	9-2-1903	2 days ...	80 C.C.—S., 3rd day 80 C.C.—S., 4th day 100 C.C.—S., 5th day 120 C.C.—S., 6th day 80 C.C.—S., 3rd day	Temperature under 100° F. 8th day Temperature normal 10th day	Cure. Discharged 21-3-1903.
II.	M	22	Engineer	12-2-1903	2 days ...	100 C.C.—S., 3rd day	Died 4th day	Generalised <i>Pestis</i> .
III.	M	17	Grocer's assistant	15-2-1903	(?)	120 C.C.—S., 15-2-03 120 C.C.—S., 16-2-03 80 C.C.—S., 17-2-03 120 C.C.—S., 23-2-03 100 C.C.—S., 8-3-03 80 C.C.	Died 81st day	Plague septicæmia and exhaustion.
IV.	F	8	Schoolgirl	19-2-1903	7 days ...	100 C.C.—S., 8th day	Died 9th day	Generalised <i>Pestis</i> .
V.	M	31	Draper	Died at home	4 days ...	200 C.C.—S., 5th day	Died 7th day	Generalised <i>Pestis</i> .
VI.	M	45	Produce merchant	11-3-1903	4 days (unable to work) (14 days malaise anorexia)	120 C.C.—S., 5th day 120 C.C.—I., 8th day	Temperature under 100° F. 11th day	Cure. Discharged 4-5-1903.
VII.	F	20	Printing office	12-3-1903	2 days ...	320 C.C.—S., 3rd day 120 C.C.—S., 4th day	Temperature under 100° F. 8th day	Cure. Discharged 28-4-1903.
VIII.	F	11	Schoolgirl	14-3-1903	1 day ...	160 C.C.—S., 2nd day 100 C.C.—S., 3rd day 120 C.C.—I., 3rd day	Temperature under 100° F. 7th day	Cure. Discharged 2-6-1903.
IX.	F	25	Domestic	23-3-1903	5 days ...	120 C.C.—S., 6th day 120 C.C.—I., 7th day	Temperature under 100° F. 8th day	Cure. Discharged 28-5-1903.

X.	M	50	Employed at Bacteriological Institute	1-4-1903	...	4 days ...	...	120 C.C.—S., 5th day 160 C.C.—L., 5th day	Temperature under 100° F. 7th day	Cure. Discharged 10-5-1903.
XI.	M	12	Schoolboy	Chilón's Hospital, 5-4-03	...	2 days ...	...	...	Case recognised P.M. (diagnosed Typhoid)	Death. Generalised <i>Pestis</i> 5th day.
XII.	F	29	Housewife	10-4-1903	...	7 days ...	...	Nil	Temperature practically normal throughout	Cure. Discharged 13-6-1903.
XIII.	M	30	Sanitary carter	20-4-1903	...	4 days ...	...	120 C.C.—S., 5th day 120 C.C.—S., 6th day	Temperature under 100° F. 8th day	Cure. Discharged 23-5-1903.
XIV.	M	20	City boot factory	24-4-1903	...	2 days ..	...	200 C.C.—L., 3rd day 200 C.C.—S., 4th day	Reported elsewhere	Death 9th day. Lobar pneumo-coccal pneumonia.
XV.	M	19	City cement warehouse	26-4-1903	...	9 days ...	...	200 C.C.—S., 10th day 120 C.C.—S., 11th day 160 C.C.—L., 12th day 160 C.C.—L., 13th day 200 C.C.—L., 16th day 120 C.C.—S., 20th day 140 C.C.—S., 21st day	Reported elsewhere	Death 23rd day. Lobular plague broncho-pneumonia.
XVI.	M	10	Schoolboy	2-5-1903	...	2 days ...	...	200 C.C.—L., 3rd day 160 C.C.—S., 4th day	Temperature under 100 F. 3rd day	Death 5th day. Cardiac failure.
XVII.	M	19	Carter	3-5-1903	...	2 days ...	...	120 C.C.—S., 3rd day 160 C.C.—S., 4th day 200 C.C.—L., 5th day	Temperature under 100° F. 8th day	Cure. Discharged 13-6-1903.
XVIII.	F	12	Schoolgirl	16-5-1903	...	1 day ...	...	160 C.C.—S., 2nd day 160 C.C.—S., 3rd day	Temperature under 100° F. 5th day	Cure. Discharged 13-6-1903.
XIX.	M	33	Chinese fruiterer	General Hospital, 23-5-1903	Case diagnosed P.M.	Death. Generalised <i>Pestis</i> .

TOTALS.—Plague Hospital Cases, 15. Deaths, 5. Total serum, 5,960 C.C.

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APPENDIX E.

BACTERIOLOGICAL REPORT.

(Extracts from a Report on the four outbreaks in Brisbane).

PLAGUE INVESTIGATIONS.

The first case of plague during the fourth epidemic occurred on the 8th February, 1903, and up to the present time fifty-four suspected cases have been examined, of which nineteen (Brisbane) were proved positive by bacteriological examination.

In all suspected cases of plague in the living subject a specimen of lymph, gland, or sputum was obtained. From *post-mortem* cases it is customary to examine portions of the spleen, liver, lung, and kidney, and any suspicious-looking lymphatic glands. In every case, with few unavoidable exceptions, as shown in the accompanying table, the material is submitted to the three following tests:—

1. The microscopical examination of stained specimens for *B. Pestis*.
2. Inoculation of the suspected material on culture media.
3. Subcutaneous inoculation of a guinea-pig.

* * * * *

4. During the classification and examination of rats I occasionally came across a hybrid variety which, from the small ears and very long tail and reddish-brown colour of its coat, was evidently a cross between the *Mus Decumanus* and the *Mus Alexandrinus*.

* * * * *

During the last plague outbreak in Townsville I found, as a result of examining a large number of rats captured on the wharves and in various warehouses, stores, &c., in the city and suburbs, that the brown species was in a very decided minority, while, at about the same period in Rockhampton, I found the brown rat very common, and the black extremely rare.

* * * * *

According to the number of rats received for examination during an epizootic of plague, evidently about 30 per cent. of the infected animals completely recover

In making the *post-mortem* examination, these recovered rats are readily detected by the mass of pigment (the products of an inflammatory process) in and around what was an infected gland. As each outbreak of plague gradually draws to a close, so the rats in this condition become more and more numerous, which is evidence pointing in the direction that the micro-organisms, for some reason unexplained, gradually lose a considerable amount of their virulence after a certain period during the epizootic.

* * * * *

It is a significant fact that of the many thousands of rats that have been captured alive in Brisbane comparatively few are found to harbour fleas. At the same time there is ample evidence that in many instances fleas are responsible for the spread of plague from rat to rat and from rat to man.

The following episode is particularly interesting in connection with the transmissibility of plague among rats by means of fleas, and occurred during the early part of the third epidemic of plague in Brisbane.

Mr. A. brought a half-grown live rat in a cage to the Institute. The rat was removed from the wire cage and placed in another larger one with nine perfectly healthy and nearly full-grown rats. On Mr. A. being handed back his cage, he incidentally mentioned that a member of his family had only a few days previously been removed as a plague patient to the plague hospital; he further stated that it might be of interest to know if anything was wrong with the rat that he brought, as it had been caught in his house.

Although the rat in question appeared quite lively and well, I instructed the caretaker to inform me at once should any sign of sickness appear either in this or in any of the other rats in the same cage. Four days later two of the rats were found dead and three others were sick, including the rat Mr. A. brought. These three died the next morning. *Post-mortem* and bacteriological examination revealed the fact that all five rats had died of plague: moreover, on the bodies of two of the rats fleas were found, and in the bodies of several fleas plague bacilli were discovered.

In view of the results of this investigation it was decided to destroy the remaining five rats, several of which were in a dying condition. The box was drenched inside and out with strong carbolic acid solution, and then placed in a fumigating room, and subjected for about six hours to ammonia and then to sulphurous acid gas.

On examination, each of these rats was found to be infected with plague, and in four of the ten rats examined there was a marked hæmorrhagic condition of the subcutaneous tissues. The nine healthy rats referred to had been reared at the Institute, and belonged to one family, being born about twelve months previous. They were always in a healthy condition, and on no occasion whatever were fleas or other parasites found upon them. It was, therefore, quite evident that the fleas which had been introduced with Mr. A.'s rat were solely responsible for the outbreak of plague among the nine healthy rats, although it was quite possible that Mr. A.'s rat may not have been infected at the time it was placed with the others.

It should be mentioned that the plague patient, a young boy, the son of Mr. A., had been for several weeks in the habit of capturing rats (handling them without any precaution) for the purpose of obtaining the capitation fee of 6d. per head offered by the Epidemic Board.

* * * * *

The facts in relation to a possible accidental transmission of plague from rat to rat by the agency of cockroaches are as follows.—In a room specially set apart for keeping all inoculated animals are two large stands with wide shelves on which are placed long lead-lined trays about two inches deep, containing carbolic solution; standing in these trays and surrounded by the carbolic solution are the various strong glass jars in which are kept the experimental animals. These jars are about sixteen inches high and about nine inches in diameter. Each jar contains only one animal, guinea-pig, rat, or mouse, as the case may be, and is covered with a mosquito-proof fine wire-gauze lid. On the occasion referred to in November, 1902, a healthy guinea-pig, that was being kept as a control for certain experiments, suddenly became sick and after three days it died. *Post-mortem* and bacteriological examination proved that this guinea-pig had died from a generalised form of plague, but no lesion was found to indicate that it had been infected through the skin. A careful examination revealed

the fact that in the zinc binding of the wire cover there were several very young cockroaches. These were promptly destroyed. On examination of the covers of the other adjoining jars, more young cockroaches were discovered.

It is quite evident that these cockroaches had become hidden in the zinc lining of the covers when the jars were not in use, and standing on the shelf alone, unprotected by the tray of carbolic solution.

As soon as a jar was occupied by an experimental animal the cockroaches that had been hidden from view in the zinc lining during the daytime would, after dark, crawl down the inside of the jar and feed on the animals' food. Apparently, before their presence was discovered, some of these cockroaches had fallen from a jar containing a plague-infected animal into the carbolic solution, and then swam either to the jar containing the healthy guinea-pig or to the side of the tray, and then hid away in the cover of an empty jar. In any case it was more than probable that the food had become contaminated with bacilli.

In order to ascertain whether the cockroaches had anything to do with the transmission of plague, a healthy guinea-pig was placed in a sterilised jar covered with the usual wire lid, but whose zinc lining was free from cockroaches. The jar was placed on the shelf, but not on the tray. In the course of a few days young cockroaches made their appearance, and, as usual, lived during the daytime in the zinc lining. Eventually the guinea-pig sickened and died of plague.

There is sufficient convincing evidence in this one observation to show the extreme danger which exists when insects like cockroaches can gain access to places where plague-infected animals are kept.

After this experience, the whole of the building and everything such as shelves, benches, jars, etc., were subjected to thorough and repeated disinfection, and all holes and crevices carefully closed. The result is that no cockroaches have been seen since, and although every day during the past eight months numbers of plague and healthy guinea-pigs and rats have been kept in the same jars and standing in the same trays, no symptoms of the disease has appeared in any animal unless specially infected.

* * * * *

On several occasions during the microscopical examination of specimens of blood from suspected plague rats, numerous motile micro-parasites were met with, and sometimes they were associated with plague bacilli, although there is apparently no connection between the two. These organisms belong to the protozoa, and are known as trypanosoma; moreover, they are identical in every respect with those described by Lewis and Crookshank, and found by them as existing in fully 25 per cent. of the London sewer rats (*Mus Decumanus*). So far, I have only found them in the same species of rats in Brisbane.

* * * * *

So far as I can gather, this trypanosoma found in the Brisbane rats has not been mentioned as being found in rats in any other part of Australia, although it is highly probable that, if looked for, it will be found to have a very wide distribution.

* * * * *

The first and principal series of the serum experiments were suggested by Dr. J. E. F. McDonald, in a letter dated 6th May, 1903.

Briefly summarised, the results show that Yersin's serum antipesteux—even in a single dose—possesses remarkable protective and still greater curative properties. In those cases where, after receiving serum, the animals actually died of plague, death was very considerably prolonged—in some instances until the twenty-second day—while in unprotected animals death usually follows in from four to six days after inoculation.

From a prophylatic point of view, each of the guinea-pigs injected with Yersin's serum or sediment, and twenty-four hours afterwards inoculated with *B. Pestis*, all died of plague, although the disease ran a very long course—in one instance the animal did not die until the twenty-second day after inoculation.

The animals inoculated with *B. Pestis*, and simultaneously injected with serum, or serum and sediment, recovered from an attack of plague after the twenty-second day, while the guinea-pig simultaneously inoculated with *B. Pestis* and the sediment of ten c.c. of Yersin's serum, died of plague on the eighth day.

The two most interesting and satisfactory experiments are "C3 and D3," where both guinea-pigs were inoculated with virulent plague bacilli, and subsequently—twenty-four hours in one case and forty-eight hours in the other—injected with the sediment only of ten c.c. of Yersin's serum antipesteux. Both animals became ill from the effects of the inoculation of plague bacilli, but both were completely cured.

A further series of experiments is in progress to test the effect of varying quantities and repeated injections of Yersin's serum and sediment into guinea-pigs and other animals both before and after they have been inoculated with *B. Pestis*.

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